INCREASED SOLAR ACTIVITY AND ATMOSPHERIC OPTICAL PHENOMENA.

By J. MAURER.

[*Translated from* Meteorologische Zeitschrift, November, 1915, 32:515-7.]

Further observations on the circumsolar haze corona[1]—carried out more carefully and more frequently since the beginning of this year—have yielded some most interesting results during the past summer, concerning which I here wish to publish a preliminary report, having already referred to them in Astronomische Nachrichten, No. 4813.

Recent studies and views, as is well known, have brought us to regard the sun and particularly his regions of greater activity which appear as faculæ and spots, as a mighty source of cathode radiation. At the well-known times of increased solar activity, particularly, tremendous quantities of little particles charged with negative electricity are discharged into space in the form of the rapid cathode rays, and they even invade our atmosphere, thereby giving rise to our auroral and terrestrial magnetic phenomena, according to Birkeland's theory.[2] P. Lenard, of Heidelberg, recently gave us in volume 28 of the Meteorologische Zeitschrift for 1911, a very graphic exposition of the detailed nature of these cathode rays from the sun with respect to their velocity, their magnetic deflection, and particularly their absorbability in the terrestrial atmosphere. From Störmer's [3] determinations of the lowest altitudes for the aurora, which descends to about 35 km. above the earth in our atmosphere, Lenard has already been able to compute a limiting value and also a probable absolute value of the atmospheric absorptiveness for the auroral cathode radiation. In the following I would draw attention to another form of the phenomenon of solar cathode rays in the earth's atmosphere, which touches on that portion of the actually still present electron-radiation that enters the atmosphere on the daylight side of the earth.

I have long been convinced that at times of considerably increased solar activity and precisely by reason of its cathode radiation, the latter makes known its presence during daylight by causing a special kind of aureole about the sun. A priori I expected to find it a ring-phenomenon of a somewhat large diameter, which theoretically would considerably exceed that of Bishop's Ring. Careful observations, in the company of my tireless colaborer Capt. Friederich Schmid in Oberhelfenswil, St. Gallen, upon the interesting circumsolar haze disk have further fostered this conviction.[4] The occasion of the rapidly increased solar activity of the first semester of the present year, seemed to offer a favorable opportunity to soon settle the question, perhaps, by giving redoubled attention, since my highly esteemed colleague, Prof. Wolfer, director of the Federal observatory, expressed a willingness to assist me in the principal matter of keeping fully abreast of the current sun-spot activity. This careful, systematic and simultaneous check against all the rapidly changing current occurrences in the sun, which we can call upon at any instant, is of the greatest importance.

First with the days from June 13 to 16, 1915, came the critical period, viz, a rapid pronounced increase in the formation of sun-spots [5] whereby the majority of the spot groups were newly formed, quite in contrast to the immediately preceding interval from June 4 to 13 which showed a pronounced period of rest throughout the whole spot zone. This was a particularly favorable moment.

Director Wolfer's kind communications of his daily solar survey showed very definitely that particularly about the middle of June (n. b.—the 13th to the 16th) numerous newly formed disturbances developed on the solar surface which then pointed to an almost simultaneous reawakening of activity throughout the sun-spot zone.

On June 16, from 2 to 3 p. m., I could for the first time detect with certainty a delicate, clearly marked brown fringe about the sun having a full maximum width of about 15° and projected against the marked haze disk of 70° diameter which surrounded the sun. The sky appeared blue, but showed, as it had for some days before (since June 12), a certain dirty hazy trace which was itself the sign of a slight atmospheric optical disturbance. We also had the sensation that even beyond the zone of that remarkable brown fringe of the haze corona, the whole sky had a somewhat striking veiled appearance. Prof. Wolfer added, for my benefit, the following note to his solar survey of June 19:

> During the last few days I have been repeatedly impressed by the veiled appearance of the sun, which hindered the observation of the spots and faculæ, although neither true clouds nor the light veil of haze were present. On the projection of the solar image the latter's color was a pronounced white-gray. To-day, June 19, the phenomenon is more striking than ever for the image is again heavily veiled, but of a pronounced yellow-gray, with a tone of reddish.

At noon on June 17 the above-mentioned brownish corona was no longer perceivable and the sky also seemed to be again of an irreproachable blue. On August 3 Capt. Schmid looking from his 900m. high location, which is wholly free from dust and smoke, again had the impression that there was a very delicate brownish tinge to the solar haze disk at very nearly the time when one of the larger spot-groups crossed the solar meridian; and the same experience recurred for the third time on August 19 when the outer half of the solar haze disk for a width of about 20° again showed a reddish brown, very delicate tone. In general there was also a very marked resemblance to the June phenomenon, in the considerably increased solar activity by reason of which two groups of spots accompanied by considerable new formations again crossed the sun's center.

The rapid development and disappearance of the corona here described argues against its being of the nature of an aureole produced intermittently by volcanic dust at high levels, etc. In this matter it is specially significant that on the night of June 16–17 Prof. Barnard at the Yerkes Observatory observed an auroral display [6] and that elsewhere there were also important magnetic disturbances as well as earth currents in North America. On this occasion from June 16 to 17 of this year, therefore, we undoubtedly had to do with an extensive influence of solar cathode rays, and it is hardly to be accounted an accident that at precisely the same time there appeared this brown aureole about the sun.

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[1] An introductory report appeared in the Meteorologische Zeitschrift, März, 1915, 32: 114–118.

[2] See this REVIEW, April, 1914, 42:209.

[3] *Karl Störmer:* Ueber einige Resultate photogrammetrischer Messungen der Nordlichthöhen zu Bössekop im Februar und März, 1910. Meteorol. Ztschr., 1911, 28:487–8.

[4] Compare summary by Jensen in MONTHLY WEATHER REVIEW, March, 1914, 42: 144.—C. A., JR.

[5] This rapid increase, almost a jump, in the number of sun spots during the critical June period is best expressed by the Wolfer provisional relative sun-spot numbers for June, 1915:

Day	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Relative number	9	8	7	7	23	61	72	117	139	146	149	177	154	145

[6] "Nature" (London), June 24, and July 15, 1915 *See also* abstract in this REVIEW, September, 1915, p. 445; this issue of the REVIEW, p. 546.

We shall have occasion in the future to further consider this interesting matter, in order to point out that at certain epochs of increased spot activity the resulting solar cathode ray influences produce special ring phenomena about the sun. In meteorological optics, however, these peculiar solar aureole displays will assume a special position, and later theory will have to discuss them in more detail.

A few years ago it was pointed out that there is a supposed relation between solar activity and certain phenomena in atmospheric optics. Jensen and Busch in their fundamental work [7] have attempted to further establish the opinion, expressed by Busch as early as 1893, that there is perhaps a paralellism between the secular march of the neutral points of Arago and Babinet and that of the solar activity. From the preceding paragraphs it is scarcely to be doubted that, particularly about the time of the maximum in periods of specially augmented activity, this relation actually does exist. A close comparison, as nearly synchronous as possible, between regularly executed observations of atmospheric polarization and the momentarily existant solar activity will also bring to light many interesting features. But much depends on the relative direction from which the solar emanation impinges on the earth's field and the atmosphere, and on the atmospheric conditions found at the different points on the earth. There are often considerable *local* variations in the individual forms of the phenomena.

AURORA OF JUNE 16–17, 1915.

By DOUGLAS F. MANNING.

[Dated: Alexandria Bay, N. Y., June 20, 1915.]

Several days ago I sent you a few observations on an aurora and I thought that you might be interested to learn that on the following evening there occurred a much more pronounced display which, from the inclosed clipping, must have been quite general.

[Clipping from ——.]

NEW YORK, *June 17, 1915.*—The electrical disturbance caused by the aurora borealis in the northwest last night [June 16, 1915] had a serious effect on cable and telegraph lines in the northeastern part of the United States and eastern Canada. For several hours during the early morning cable communication via the Newfoundland cables of the Western Union was all but paralyzed and the disturbances, although they diminished, were still felt up until the late afternoon.

A peculiar feature of the phenomenon was that only east and west wires were affected. Interruptions in land-line service were frequent, the wires being heavily surcharged with electricity.

The telegraph systems of the Commercial Cable Company and of the American Telephone & Telegraph Company were similarly affected. Officials of the latter company said the disturbance was felt as far south as Pittsburgh and particularly around Buffalo, although the interruptions were of short duration. * * *

The disturbance was not unprecedented, * * * but nothing so severe had occurred in 11 years.

On the evening of June 17 the aurora appeared in patches of greenish light without any particular formation, but it seemed much closer to the earth than I have ever seen it. The patches of light extended all over the northern sky, reaching overhead and occasionally to the south of the zenith; the leading feature was the tremendous speed of the light "waves" which would continually flash up from the north, the different patches lighting up and fading out in quick succession; sometimes one of the patches would show a tinge of red and yellow when at the height of its brilliancy. There were no clouds whatever present. * * * The local wireless man here had great difficulty in securing his evening reports, he claims. During the evening I turned my compass so that the needle read due north and south on its card, and on the following morning I noted that the needle pointed about 2° east of north; I am very sure that no one could have disturbed the compass box to cause the variation.

The following morning the sky was streaked with cirrus streamers, as I have so often observed after an auroral display, and it really seems as though there were some connection between the two. The cirrus streamers generally follow an aurora and are not always present during the display; the sky on the evening in question was absolutely clear and right in the heart of a "high."

[7] *Busch & Jensen.* Tatsachen und Theorien der atmosphärischen Polarisation. Hamburg, 1911. 8°.

AURORA OF JUNE 16–17, 1915, AT ASHLAND, OHIO.

Mr. S. W. Brandt, our cooperative observer at Ashland, Ohio, sent to the Weather Bureau office in Columbus, Ohio, the following account of the great aurora of the night of June 16–17, 1915:

417 VINE STREET, ASHLAND, OHIO,
*June 16, 1915.**

I am a night watchman and have just come in from the 2 o'clock [a. m. June 17] trip, having had the rare privilege of beholding the most beautiful display of northern lights that I have witnessed for many years.

The sky here has been clear of clouds all night, except a low ridge far to the north [no moon] and the view unobstructed. I first noticed the light in the north as soon as it became dark. At 11 p. m. it became very brilliant, with a primary bow far to the north and a secondary bow about midway between this and the zenith. This secondary bow extended from the far east to the far west. Streamers of white light extended from the primary bow, in a vertical position nearly to the zenith.

It was less brilliant until 2 a. m. when it became more beautiful than at any other time during the night. The secondary bow had disappeared, although the vertical streamers were still playing, and over all these from the primary bow far to the north came great waves of brilliant white light many times reaching to the zenith. They just resembled the waves of the ocean rolling out upon a low beach.

At 2:30 a. m. the secondary bow had again appeared.

At 3 a. m. [June 17] daylight had so far advanced as to render the aurora invisible.

* A later letter shows that this account was written June 17, 1915—C. A., jr.

STUDY OF THE UPPER AIR BY MEANS OF TELESCOPES.

Those of our readers who were interested in the paper by Prof. W. H. Pickering in this REVIEW for October, 1915, will find added interest in a longer article on the subject by Prof. A. E. Douglass published in the American Meteorological Journal for March, 1895 (vol. 11, no. 11). It is regretted that this reference escaped the Editor last month.—C. A., jr.